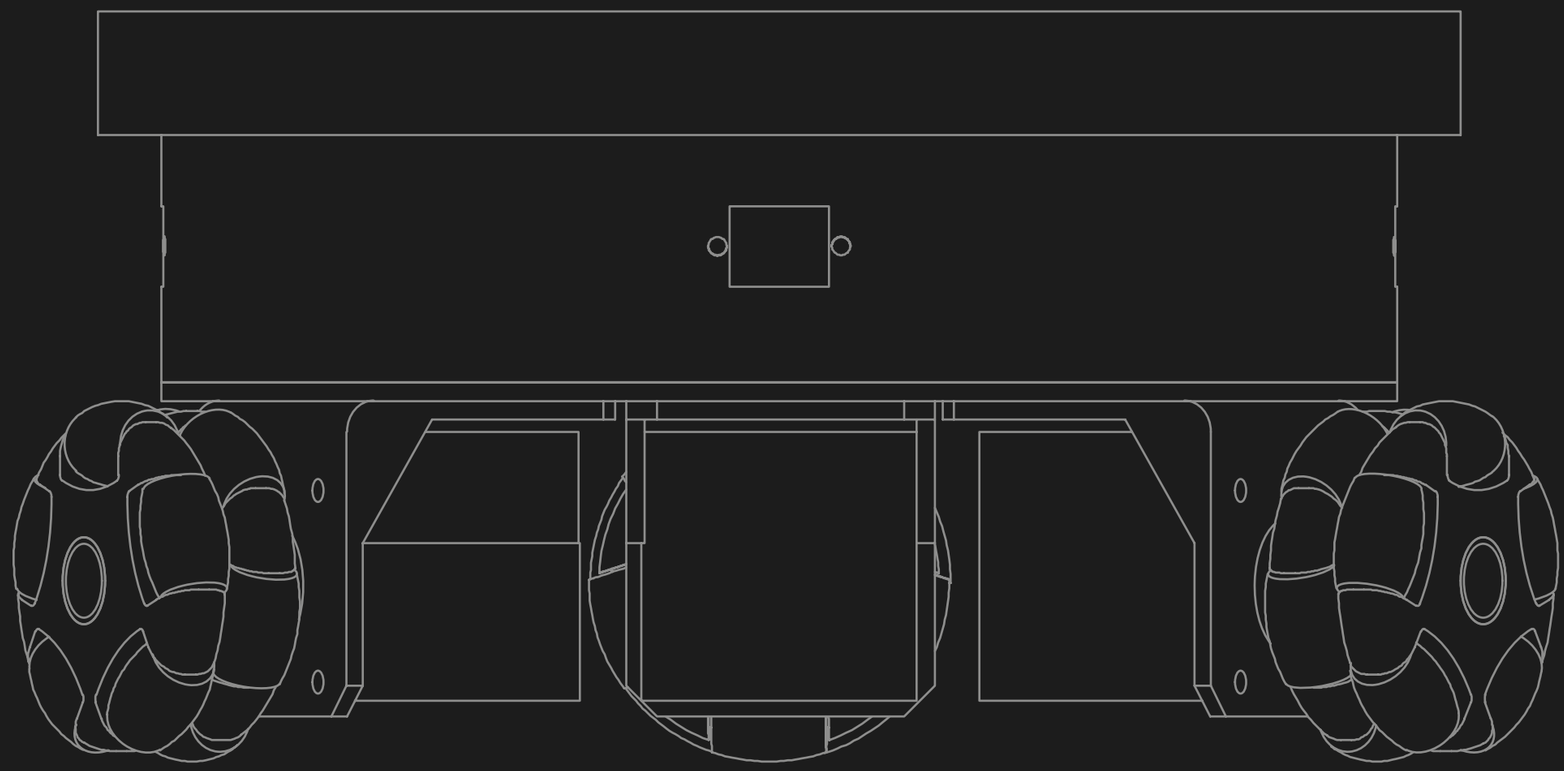


GIZMO BOT

Mechanical Teardown

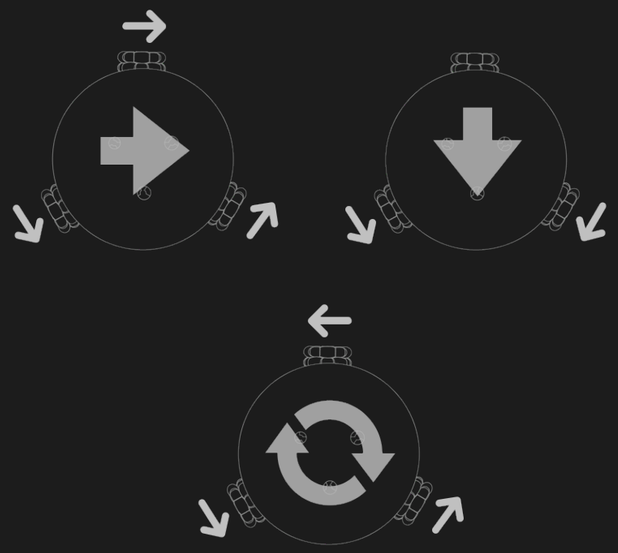
Introduction

Gizmo Bot is a unique robot designed for delivering an interactive experience to the user. It is engineered to be a precise, low cost and adaptive platform.

Materials used in the project mainly consist of 3D printed parts and stock electronics. The robot is able to withstand impact damage and can self recover from obstructions.

The entire system is modular and parts are easily replaceable. The unit can push a load and also has strong traction allowing for usage in many environments.

Omnidirectional



Gizmo Bot is an omnidirectional robot allowing for movement in all directions with ease with just three omniwheels. This makes it ideal for programmed sequences as it can fit within tight spaces and has a high level of manoeuvrability.

Parts List

A **Top Cover**
This piece protects the robot from damage whilst in motion / transport. It also serves as a expansion platform allowing for cables to pass through.

B **Main Body Piece**
This piece provides the main structural support to the robot. Inserts were added to allow the ToF sensors to simply screw in place.

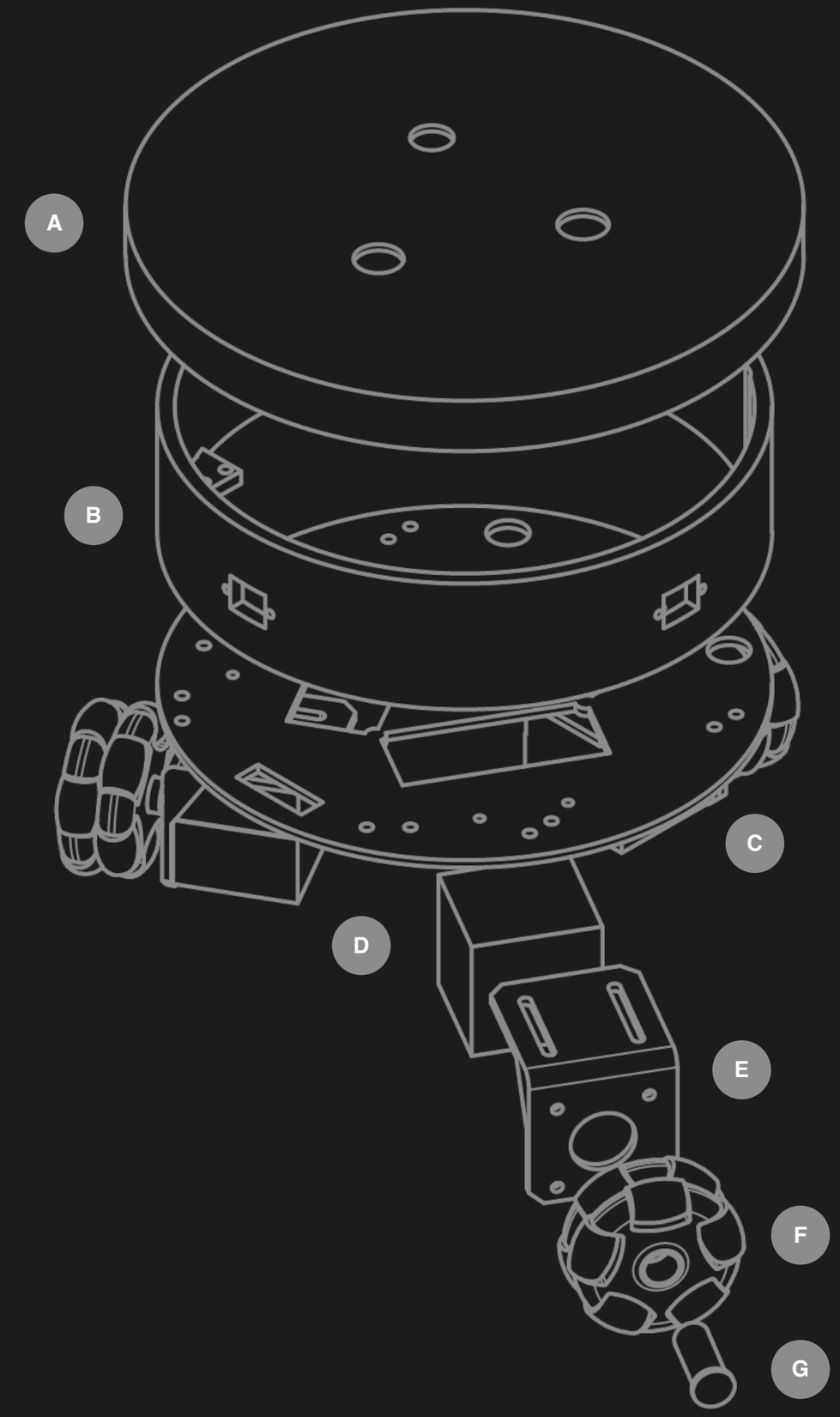
C **Bottom Mount Plate**
The bottom mount plate has mounting holes allowing for the various components to be attached in one piece via nuts and bolts.

D **NEMA 17 Stepper Motors**
The NEMA 17 stepper motors are the centre piece of the robot. They provide the precise rotation required for complex applications.

E **NEMA 17 Stepper Mount**
This part was found online[1] and is used to mount the stepper motor to the bottom mount plate.

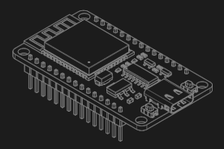
F **58mm Omni wheel**
These wheels are a standard part you can obtain and were used to achieve omnidirectional motion.

G **Wheel Stepper Hub**
This part connects the stock wheel to a stepper motor. It is adapted from a part found online[2].

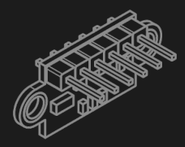


Electronics

Components

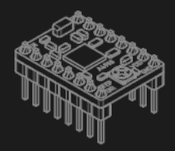


ESP32 Microcontroller
This is the main microcontroller of the Gizmo Bot. Firmware for MicroPython was flashed onto the unit. Communication is possible via Bluetooth Low Energy.

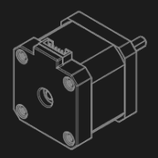


VL53L0X ToF Sensor

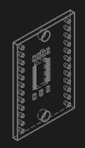
This sensor is used to calculate the distance to the closest obstacle to a high level of accuracy. It is able to operate via I2C.



A4988 Stepper Driver
This stepper driver is a cheap way of interfacing a standard stepper motor with a microcontroller. They can produce a lot of noise.

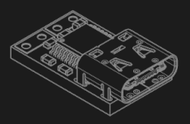


NEMA 17 Stepper Motor
These NEMA 17 Stepper motors are ideal for our application as they are very precise and have a lot of torque.



TCA9548A I2C Multiplexer
A multiplexer is used allowing the ToF sensors to be connected to the same I2C bus. Allowing for reading of multiple sensors at once.

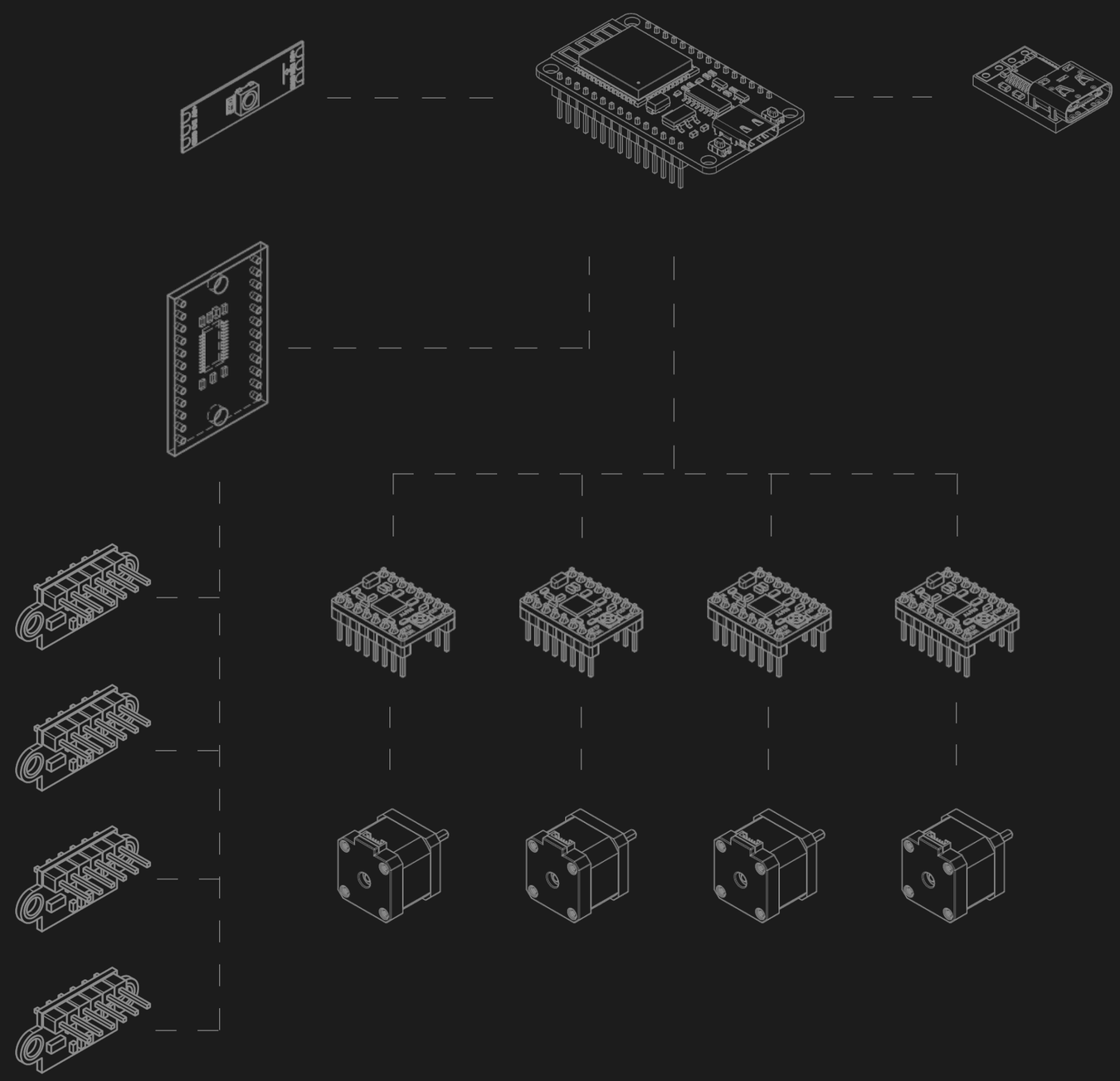
Neopixel Strip (WS2812B)
A WS2812B strip is used to allow for individually addressable LEDs to be present on the robot as an output.



PDC004 USB-C PD 12V Decoy

This small device converts a standard Power Delivery power bank into a 12V supply with approx. 2.4A limit ideal for our application.

Component Connections

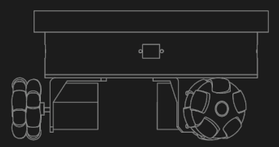


Mobile App

The Gizmo Bot comes with a companion mobile application for iOS. Natively coded in Swift, it connects to the ESP32 that controls the Gizmo Bot I/O via Bluetooth Low Energy (BLE). The experience offers a seamless connection experience.

Modes

Gizmo Bot has many autonomous modes that can be found through the scripts screen offering an exciting physical human interaction between two actors.

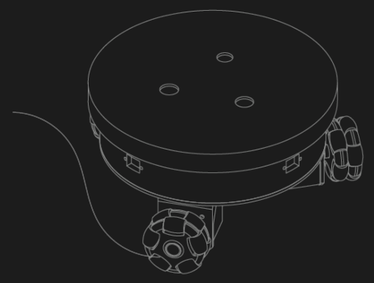


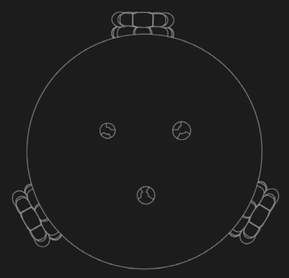
Roam

The roam mode allows the robot to navigate it's surrounding environment and explore. Using the ToF sensors the rotates and accelerates to avoid any obstacles that surround it.

Follow Me

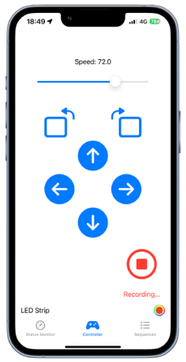
The "follow me" mode sets the robot to follow your hand allowing you to control its movements in a a playful physical interaction. The LED ring will also illuminate in the chosen direction.





Radar

The robot rotates 90 degrees or 12 "ticks" to build up a radar plot of the room that can be displayed in the App. Each ToF is composited together using trigonometry to give a final result.

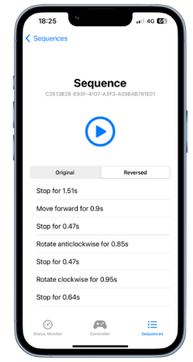


Controller

The controller screen gives you a directional pad giving you manual control of the robot. A record button is also present to save a sequence.

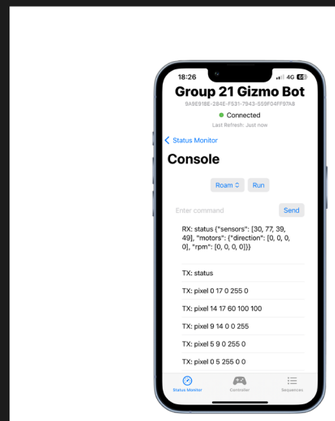
Status Monitor

The status monitor screens allow you to check the connectivity status of your robot, access important diagnostic tools and access the debugging console.



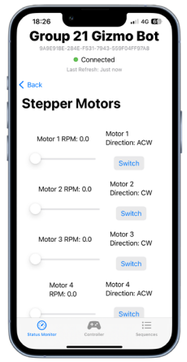
Sequencer

The sequencer allows you to program sequences that move your Gizmo Bot, change its appearance and return the bot to its original position.



Scripts

The scripts screen allows you to access three functions as standard. These are detailed to the left. Additional scripts are easily added and integrated.



Stepper Motor

The stepper motor control screen allows you to view the status of all stepper motors at a moment in time. This live updating view is invaluable in the case of connectivity issues.

ToF Sensor

The ToF sensor menu allows you to access your robot ToF sensor readings. A visual indication is also giving on the robot in the form of a NeoPixel ring.

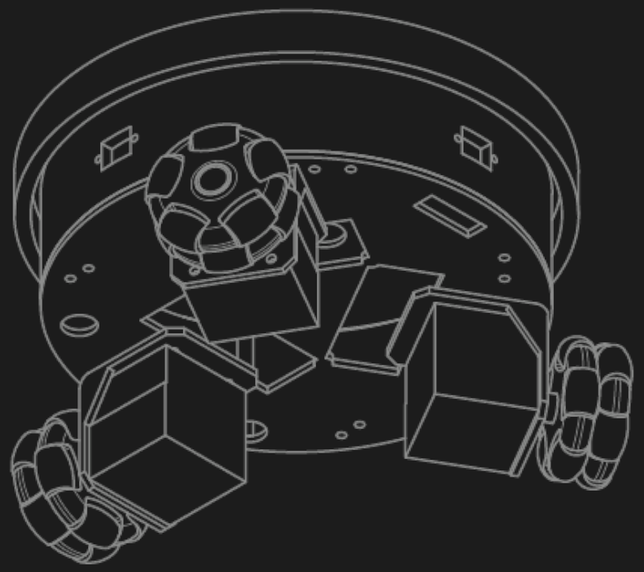
Capabilities

Looking to the future...

The current capabilities of the Gizmo Bot is just the beginning. The unit has been designed with the future in mind with consideration given to possible features that may need to be added.

Gizmo Bot also has the advantage of most of the heavy processing being handled by a command and control server. This allows for new features to be added without the micro controller requiring flashing with new firmware.

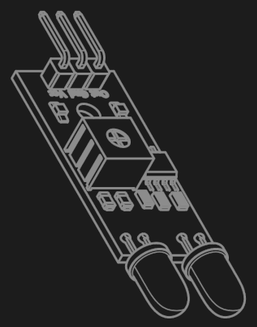
As Gizmo Bot is a human collaboration based robot, it can be programmed to perform automated tasks that can then be requested by an operator similar to robots used in Industrial Applications today.



Infrared

The unit has space on the underside intended for a standard infrared proximity sensor ideal for line tracking applications or similar.

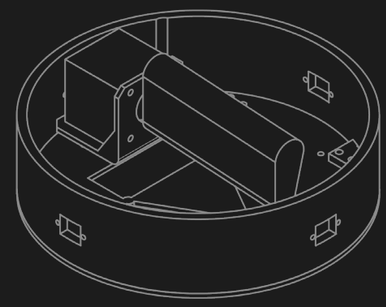
There is also a mount we designed with inserts.



Additional Accessories

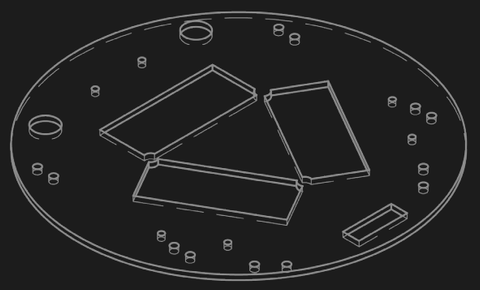
The Gizmo Bot has been made with additional accessories in mind. A 4th stepper motor is available allowing for a wide range of motion possibilities.

One unit that was tested was a lifting device for working with racks in a warehouse.



Mounting

There is additional mounting on the unit with the consideration that additional components can be added with ease. There is also additional space for wires within routing channels.



Modular

No component is designed to be fixed in place. Parts can be replaced as required allowing the Gizmo Bot to have a longer shelf life.

Swarm

A swarm of Gizmo Bots could be created allowing a collection of autonomous “drones” that are able to perform a task such as creating a light show.

References

1. https://grabcad.com/library/nema-17-bracket-1
2. https://www.thingiverse.com/thing:4207170

Code references are provided in-line within files.